REPLY

The Examiner rejected claim 1 under 35 USC §112, second paragraph, as being indefinite. Claim 1 has been amended to obviate the Examiner's rejection. The scope of the reflector comprising should now be clear due to the accepted use of the words "wherein" and "comprises".

The Examiner objected to claims 1, 2, 4-9, 15, 16, 19, 23, 25 and 26 because of various informalities. The Examiner indicated that the meaning of "characteristic lateral size" is not clear. The meaning of "characteristic lateral size" is sufficiently definite, and would be clear to one of ordinary skill in the art upon reading the specification. The specification additionally clearly defines the meaning of "characteristic lateral size". The meaning of "characteristic lateral size" is clearly defined in the specification on page 12, lines 9-18, and on page 13, lines 4-7, where it indicates that "the characteristic lateral size d_m may be selected as the dimension in one predetermined lateral direction, or may be defined as an average value of the dimensions in two lateral directions". Accordingly, the meaning of "characteristic lateral size" should be clear and sufficiently definite to one of ordinary skill in the art.

Claims 6 have been amended to more specifically define the range to a specific size range having an ending and starting point. Claim 7 has been amended to use the generally accepted term "substantially" in defining the maximum lateral size.

In claims 27-29, the Examiner objected to a term of a "characteristic dimension". Claim 23, on which claims 27-29 depend, specifically defines a "characteristic dimension". Claim 23 recites "correlating at least two of the following characteristic dimensions". Claim 23 then recites "a first characteristic lateral size", "a second characteristic lateral size", and a "vertical distance". Accordingly, the meaning of "characteristic dimensions" is clearly a lateral size dimension, or a vertical distance dimension, as specifically recited in independent claim 23. Accordingly, one skilled in the art would clearly recognize that a "characteristic dimension" is either a lateral dimension or a vertical distance of the type specifically recited in independent claim 23.

The Examiner rejected claims 1-3, and 12-13 under 35 USC §102(b) as being anticipated by Shieh, et al.

The Examiner also rejected claims 4-11 and 14-16 as being unpatentable over Shieh, et al in view of Ueki.

The Examiner also rejected claims 17-22 under 35 USC §103(a) as being unpatentable over Shieh, et al in view of Sopra et al

The Examiner also indicated that method claims 23-28 are rejected for the same reasons as applied above to rejected apparatus claims 1-22, and that for claim 29 a process margin is obvious in the art, since this has been well established in industry to accommodate the individual error of the component in manufacturing process.

Shieh et al discloses a low-resistance VCSEL. Shieh et al uses high resistance, low conductance portions 38 adjacent mirror pairs 39. The portions 38 are preferably in the diameter of the mirror pairs 39, outside the desired optical mode, and reduces electrical conductance resulting in funneling of the current into the active region of the optical mode. Implants 42 aid in preventing migration of defects in carriers.

Ueki discloses a VCSEL having a light confinement region, or current narrowing region 12, and an outgoing region 11. The light confinement region 12 has a diameter D2 that is greater than or equal to 12 micrometers, and the outgoing region 11 has a diameter D1 that is at least 1 micrometer smaller than the diameter D2. The laser light is multimode.

Sopra et al discloses a VSCEL having a phase matching layer and a structure for the stabilization of one of two linear polarization directions.

Claim 1 is not anticipated by Shieh et al. The implants 42 disclosed in Shieh et al are not adapted to generate increased optical losses of the resonator with respect to higher order modes, as claimed in claim 1. Shieh et al discloses the only function of the implants 42 is for preventing migration of defects and carriers. In Shieh et al, the portion 38 cannot be considered as forming in the aperture, as claimed in claim 1, because the diameter of the aperture formed by the portion 38 is clearly less than the diameter of the second mirror stack 37, or mesa, disclosed in Shieh et al. Claim 1 specifically recites that the second characteristic lateral size d_m of the mesa is smaller than the first characteristic lateral size d_{ox} of the aperture. Accordingly, claim 1 cannot be anticipated by Shieh, et al. Support to the amendments made to claim 1 can be found in the specification and in particular on page 17, lines 22-25.

The present invention is directed to the optimization of a vertical cavity surface emitting laser (VCSEL), which emits the fundamental transverse radiation mode only and that adopts a second characteristic lateral size d_m, being adapted to generate increased optical losses of the resonator with respect to the higher order modes. The present invention therefore, results in increased performance of the vertical cavity surface emitting laser, and enhances performance in the fundamental transverse radiation mode. The aperture formed in Shieh et al, specifically

portion 38, is used for funneling the current into the active region of the optical mode.

The aperture formed by the light confinement region 12 in Ueki serves as a current narrowing region and aids in reducing the beam divergence angle and operates in a multimode.

Accordingly, none of the references cited by the Examiner disclose the recited relationship of the second characteristic lateral size d_m being smaller than the first characteristic lateral size d_{ox} and being adapted to generate increased optical losses of the resonator with respect to higher order modes. Therefore, the present invention is intended to operate in only the fundamental transverse radiation mode.

Independent method claim 23 recites a method of forming a vertical cavity surface emitting laser which emits the fundamental transverse radiation mode only, including the method step of correlating at least two specifically recited characteristic dimensions, so as to increase optical losses of higher radiation modes. Accordingly, the method step of correlating at least two specifically defined characteristic dimensions for the purpose of increasing optical losses of higher radiation modes is not disclosed in the references cited by the Examiner. Therefore, the references cited by the Examiner cannot anticipate the method steps as recited in independent claim 23.

New claims 30 and 31 have been added to more particularly recite the present invention. Claim 30 recites a vertical cavity surface emitting laser having a desired output wherein the second predetermined lateral dimension and the predetermined thickness are selected based on an actual measurement of the first predetermined lateral dimension, so as to maintain the desired output of the vertical cavity surface emitting laser. Accordingly, the vertical cavity surface emitting laser, as recited in claim 30, utilizes a correlation, or interrelationship, between different dimensions so as to maintain a desired output.

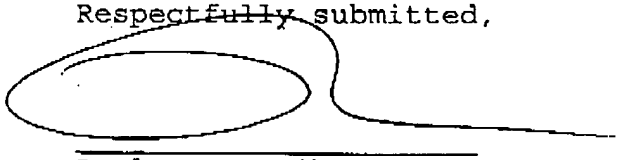
Independent method claim 31 recites a method of making a vertical cavity surface emitting laser having a desired output, including the step of measuring the first intended predetermined lateral dimension of the aperture to obtain an actual lateral dimension formed in combination with the method step of calculating an adjustment to a device dimension of subsequent layers, so as to compensate for the deviation between the intended predetermined lateral dimension of the aperture and the actual lateral dimension formed, whereby the desired output is maintained.

Support for new claims 30 and 31 can be found in the specification and in particular on pages 17-18.

The present invention improves over the prior art devices cited, by correlating at least two device dimensions so as to optimize single mode emission and thereby improve performance as well as relaxing the need for precise control over the lateral size of the oxide aperture d_{ox}.

Accordingly, it is respectfully requested that the Examiner reconsider the present application in view of this Amendment and Reply and indicated allowable subject matter.

Respectfully submitted,



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